

## Temperature as a driver of cyanobacteria blooms in the San Francisco Estuary Delta: evidence from experimental enclosures

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**Abstract:** Blooms of toxic cyanobacteria (cyanoHABs), including the colonial *Microcystis aeruginosa*, have become a regular feature of the summer ecology of the San Francisco Delta since the late 1990s. CyanoHAB appearance in the Delta occurred at the same time as other changes to the ecosystem, including declines in some phytoplankton taxa and reductions at higher trophic levels, including threatened and endangered fish. At present it is unclear what environmental triggers have allowed cyanoHABs to proliferate in the estuary although changes in nutrients, improved water clarity, water residence time and increased water temperature all may be important. A series of 20-L enclosure experiments were conducted during the summer 2011, using water collected at sites within the Delta, with the goal of understanding how temperature (18°C versus 23°C) influences phytoplankton dynamics. Enclosures were monitored for 96-hr for chlorophyll-a, dissolved inorganic carbon (DIC) and nutrients, as well as phytoplankton community composition (for cells >20-µm). Unlike previous years, *Aphanizomenon* and not *M. aeruginosa* was the dominant cyanoHAB in Delta waters. Chlorophyll-a increased in all experimental treatments, but accumulated more quickly at 23°C compared to 18°C. DIC drawdown, indicating primary production, was also greater in enclosures held at 23°C. After 96-hr, diatoms were numerically dominant at 18°C while cyanoHABs were numerically dominant at 23°C. Among the cyanoHABs counted, *Aphanizomenon* was consistently dominant at 18°C, while *M. aeruginosa* dominated at 23°C. Similar experiments were conducted to test the effect of light on phytoplankton, including cyanoHABs, and showed no clear relationships. These results suggest a link between the proliferation of cyanoHABs and Delta water temperatures, and provide clues about how temperature may influence the type of cyanoHAB present in the Delta in the future.

**Statement of Relevance:** The persistence of summer cyanoHAB blooms in the Sacramento – San Joaquin Delta represent an ecosystem level change in the environment. CyanoHABs have the potential to affect water resources, via production of cyanotoxins harmful to human health, altered foodweb structure, and altered aesthetics.